



Disaster and Emergency Management Resources

Floodproofing Measures

Floodproofing is a process for preventing or reducing flood damages to the structure and/or to the contents of buildings located in flood hazard areas. For the most part, it involves altering or changing existing properties. However, it can be incorporated into the design and construction of new buildings. There are three general approaches to floodproofing.

Raising or Moving the Structure

- Raising or moving a structure so that floodwaters cannot reach damageable portions of it is an effective floodproofing approach.
- One technique is to raise the structure in place so that the lowest floor is above the expected level of floodwaters. This is commonly referred to as "elevation." The structure is jacked up and set on cribbing, and a new or extended foundation is constructed underneath the structure.
- In areas where flooding is likely to have high velocities, elevation on piles or columns without enclosing the lower area is the only recommended floodproofing technique.
- Cost is an important factor to consider in elevating structures. Lighter wood frame buildings are easier and cheaper to raise than masonry buildings. Not only are masonry buildings more expensive to raise, but they also are susceptible to cracks. If homeowners opt for elevating the building, they must not then place contents or materials susceptible to flood damage on the new lower level.
- A second technique is to move the building to another location where floodwaters cannot reach it. This technique is commonly referred to in floodproofing literature as "relocation."
- Relocation of the structure can be to a flood-free location on the same lot or to another flood-free location. There are many qualified contractors experienced in relocating or elevating buildings.
- Relocation is an appropriate technique in high hazard areas where continued occupancy is unsafe, where owners want to be free from flood worries, and where communities have determined that the open space gained could be used for more appropriate floodplain activities.
- A major concern in evaluating the feasibility of relocation is cost. Acquiring a new lot, constructing a new foundation, and paying for moving contractors and new landscaping must be considered. There are several government programs that provide financial assistance or that acquire floodplain properties.

Constructing Barriers

- Constructing barriers is an effective approach to stopping floodwaters from reaching the damageable portions of structures.
- Two techniques are employed in constructing barriers. The first technique involves constructing free-standing barriers that are not attached to the structure. The three primary types of free-standing barriers used to reduce flood damages are
 - **Berms** - A berm is typically an earthen structure, constructed from local compacted fill, that stops flood water from reaching the building. To be effective over time, berms must be constructed out of suitable materials (i.e., impervious soils) and with correct side slopes.
 - **Levees** - Levees, which are similar to berms, are also earthen structures of compacted local fill. Levees are usually constructed along riverbanks to prevent the floodwaters from spilling over and flooding structures. Berms, on the other hand, serve the same purpose but usually are constructed closer to the structures themselves. Both berms and levees are generally appropriate for floodproofing a home where floodwaters are less than 6 feet deep.
 - **Floodwalls** – Floodwalls are usually constructed out of reinforced concrete and anchored into the ground. Floodwalls, because of their greater cost, are usually not used to protect homes. Berms, levees, and floodwalls may not be appropriate for homes with basements since they are more susceptible to underseepage.
- The second technique that can be used to construct a barrier against floodwaters is known as "**dry floodproofing.**"
 - With this technique, a building is sealed so that floodwaters cannot get inside.
 - All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or impermeable sheeting.
 - Openings such as doors, windows, sewer lines, and vents are closed with permanent closures or removable shields, sandbags, valves, etc.
 - This floodproofing technique is appropriate only where floodwaters are less than 3 feet since most walls and floors in buildings will collapse under higher water levels.
 - A professional engineer should be consulted when considering dry floodproofing since threat of collapse from hydrostatic pressure (the pressure on standing water) is a major concern with this technique.
 - The dry floodproofing technique is not as successful on buildings with crawl spaces or basements since those structures are difficult to protect from underseepage.

Wet Floodproofing

Wet floodproofing involves modifying a structure to allow floodwaters inside, but ensuring that there is minimal damage to the building's structure and to its contents.

- Wet floodproofing allows the floodwaters to enter the structure. The building is modified so that utilities and furnaces are protected or relocated to an area above the anticipated flood level.
- Wet floodproofing is often used when dry floodproofing is not possible or is too costly.
- Wet floodproofing is generally appropriate in cases where an area is available above flood levels to which damageable items can be relocated or temporarily stored.
- This approach is also appropriate for structures with basements and where other floodproofing measures will not be effective.

Additional Considerations

Basement Protection

- Flooding in basements and the lower levels of split-level houses is especially difficult to prevent. These areas are susceptible to seepage under berms, floodwalls, or dry floodproofed walls.
- Flooding of below-grade areas may occur through sewer pipes and drainage sumps, which are direct connections to flooded areas or from high groundwater caused by flooding. The basic sources of basement flooding and ways to prevent that flooding vary according to the type of flooding.
- The first source of flooding in basements is failure or overload of the sub-drainage system's sump pump. Installing alternate power sources, improving pump maintenance, and adding or increasing the size or number of pumps could eliminate this source of flooding.
- Water backing up from sewer lines represents a second source of basement flooding. This could be eliminated by installing in-line valves or check valves.
- Seepage through cracks in the walls, a third source of basement flooding, may be eliminated by sealing the walls with commercial waterproofing compounds.
- The fourth source of basement flooding is surface water flooding. Sealing basement windows and other above ground openings could prevent surface flooding from entering a basement.

- In cases where flooding causes high groundwaters, hydrostatic pressures are usually too great to allow dry floodproofing of a basement. Therefore, wet floodproofing by moving basement equipment and contents and allowing the water to enter the basement is often the only available means of reducing damages (see Wet Floodproofing).

Emergency Measures

- Emergency measures are temporary and usually implemented after a flood warning is issued. They are not permanent floodproofing installations, and they require removal and cleanup after floodwaters have receded.
- The most common measure used to keep water out of the structure is by erecting a sandbag wall. This requires a considerable amount of time, money, and manpower.
- Other temporary barriers can be erected with sand, rock, and lumber provided they are made watertight with impermeable sheeting.
- Contents are best protected by moving them to higher floors of the structure or to higher ground. Some commercial establishments have modified their equipment by installing quick utility disconnects and placing equipment on pallets for protection.

General Cautions Applicable to Floodproofing

- Most floodproofing techniques should be formulated and designed by experienced personnel (engineers or contractors) to ensure adequate consideration of all factors that could affect the techniques' effectiveness.
- Floodproofing techniques cannot be installed and forgotten. Maintenance must be performed on a scheduled basis to ensure that the floodproofing techniques adequately protect the structures over time.
- Floods may exceed the level of protection provided. Therefore, when any of the floodproofing techniques are chosen, considerations should be given to, purchasing flood insurance as well as securing the property and vacating the premises during floods.

Condensed from a report of the U.S. Army Corps of Engineers National Flood Proofing Committee entitled "Flood Proofing Techniques, Programs, and References"